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Assistant Commissioner for Patents
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Date: 09/27/00

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Sir:
Transmitted herewith for filing is the patent application of:

Siemens Westinghouse Power Corporation

Inventor(s):

FRANKLIN TIMOTHY EMERY

For (title): POWER SYSTEM HAVING STATOR COILS FOR GRADING VOLTAGE BETWEEN INNER VENT TUBES AND COIL STRANDS AND ASSOCIATED METHODS

This application includes:

18 pages: specification, claims, abstract, and title page
7 sheets of drawings, X formal/___informal containing Figures 1-9
Also enclosed is:

X Declaration and Power of Attorney
X An assignment of the invention to Siemens Westinghouse Power Corporation
__ A certified copy of a ____ application.
X Information Disclosure Statement pursuant to 37 CFR 1.56.

The filing fee has been calculated as shown below:

						FEE
BASIC FEE OTHER THAN SMALL ENTITY						$ 690
TOTAL CLAIMS			EXTRA			
19	- 20	=	0	x $18.00	=	$ 0
INDEP CLAIMS						
4	- 3	=	1	x $78.00	=	$ 78
*MULTIPLE DEPENDENT CLAIM PRESENTED				+ $260.	=	$ 0
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All correspondence related to this application should be sent to:

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Dated: 09/27/00

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POWER SYSTEM HAVING STATOR COILS FOR GRADING VOLTAGE BETWEEN INNER VENT TUBES AND COIL STRANDS AND ASSOCIATED METHODS

Field of The Invention

This invention is related to the power generation industry and, more particularly, to the field of electrical power generators.

Background

In the power generation industry, high voltage coils are often used in a stator of power generators. In inner cooled high voltage stator coils, cooling members having a tubular shape or configuration, and known as cooling tubes or vent tubes, are often used integral to or positioned within the outer confines of the coil construction. The cooling tubes are made of conductive material, e.g., a metal, and serve to pass coolant, e.g., air or hydrogen, through them to remove copper (or other conductive material) conductor heat. The tubes are usually surrounded by copper strands of the coil and extend the full length of the coil. For example, many coil designs or configurations contain five (5) or more cooling tubes in a single stack.

All of the vent tubes in a coil stack are insulated from each other and insulated from the copper strands, e.g., to prevent flow of machine or generator current in the tubes. No current from the generator is allowed to

flow in the vent or cooling tubes, and the tubes are conventionally not designed to carry generator current, e.g., the tubes often have a thin-wall type construction or design. Examples of some vent or cooling tube configurations can be seen in U.S. Patent No. 5,323,079 by Nieves et al. titled *"Half-Coil Configuration For Stator"* and U.S. Patent No. 5,723,920 by Markovitz et al. titled *"Stator Bars Internally Graded With Conductive Binder Tape."*

In these systems, however, and with voltage on the stator coil, a large percentage of voltage often appears between the metal vent tubes and the copper strands of the coil. In order to prevent the flow of machine or generator current in the vent tubes, both the copper strands and the vent tubes are insulated. This voltage potential, if allowed to reach high values, can destroy the copper strand insulation and the vent tube insulation which respectively surrounds the strands and the tubes as described above. Therefore, vent tube voltage grading is needed to prevent the buildup of voltage between the vent tubes and the copper strands.

The method of construction of stator coils conventionally used to address this need for voltage grading is the connection of external resistors between the copper strands and the vent tubes. On some coil designs, however, no space is available to connect the resistors externally to the coil. In addition, it is impossible or can be very difficult to make connections to the inner stack or arrangement of vent tubes and, accordingly, grading cannot be readily achieved. Even though the voltage on the inner vent tubes is much lower than the top and bottom vent tubes in a stacked configuration, some magnitude of protection is still needed for these vent tubes as well.

Summary of the Invention

In view of the foregoing, the present invention advantageously provides a power generation system and associated methods having voltage grading to inner vent tubes of stator coils of a stator of a power generator. Also, the present invention advantageously provides a stator having stator coils with a compact voltage grading arrangement for effectively providing voltage grading capabilities to inner vent tubes of the coils. The present invention still also advantageously provides a power generation system, stator coils, protecting devices, and associated methods which compactly reduce voltage buildup situations between venting devices and conductive strands of coils. Further, the present invention advantageously provides a stator coil and associated methods which significantly reduces insulation failure in stator coils of a power generation system.

More particularly, the present invention provide a stator for a power generation system which preferably includes a plurality of high voltage stator coils. Each of the plurality of high voltage stator coils includes a plurality of metal strands, a plurality of vent members positioned adjacent the plurality of metal strands, and compact voltage grading means contacting each of the plurality of vent members and the plurality of metal strands for grading voltage between the vent members and the metal strands to thereby prevent an over voltage condition. For example, the metal strands and vent members are often positioned in a stacked configuration and the compact voltage grading means contact even the inner vent members of the stack.

Additionally, the present invention provides an overvoltage protector for a power generation system. The overvoltage protector preferably includes at least a first conductive strip member positioned to contact one of a plurality of vent members, a voltage grading layer

of material positioned to contact the first conductive strip member, and at least a second conductive strip member positioned to contact the voltage grading layer and at least one of a plurality of conductive coil strands forming a portion of a high voltage coil.

The present invention still further provides a method of grading voltage between internal vent members and conductive strands of a high voltage coil of a power generation system. The method preferably includes connecting conductive portions of each of a plurality of internal vent members to a plurality of conductive strands of a high voltage coil. The connecting step for each vent member can advantageously include forming an opening in insulation surrounding the vent members, positioning a first conductive strip member to contact conductive portions of the vent member, positioning a voltage grading layer of material to contact and overlie the first conductive strip member, and positioning a second conductive strip member to contact the voltage grading layer and at least one of the plurality of conductive strands. The voltage grading layer preferably includes a plurality of layers of conductive tape, and the step of positioning the voltage grading layer preferably includes adhering a first layer of conductive tape to the first metal strip member and the insulation surrounding the vent member and adhering a second layer of conductive tape to the insulation and the second conductive strip member.

Brief Description of the Drawings

Some of the features, advantages, and benefits of the present invention having been stated, others will become apparent as the description proceeds when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a fragmentary perspective view of a power generator showing a plurality of stator coils according to the present invention;

FIG. 2 is a fragmentary perspective view of a stator coil having voltage grading between inner vent tubes and the strands of the coil according to the present invention;

FIG. 3 is a fragmentary perspective view of construction of an over voltage protector of a stator coil having voltage grading between inner vent tubes and the strands of the coil according to the present invention;

FIG. 4 is an exploded perspective view of a stator coil according to the present invention;

FIG. 5 is another fragmentary perspective view of construction of an over voltage protector of a stator coil according to the present invention;

FIG. 6 is a fragmentary perspective view of a stator coil according to the present invention;

FIG. 7 is a schematic view of a system for grading voltage of a stator coil between inner vent tubes and the coil according to the present invention;

FIG. 8 is a circuit diagram of an equivalent circuit of inner coil distributed capacitance of a stator coil; and

FIG. 9 is a graph of applied voltage versus tube-to-copper voltage with and without vent tube grading according to the present invention.

Detailed Description of Preferred Embodiments

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein. Rather, these illustrated embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers

refer to like elements throughout, and prime and double prime notation if used indicate similar elements in alternative embodiments.

An equivalent circuit showing the internal capacitance of a stator coil **20** is illustrated in FIG. 7. For example, with a 60Hz or 50Hz voltage (coil voltage) applied to the stator coil **20** between the metal coil strands **22**, i.e., copper, and the conducting outer electrode of the coil **20**, the applied AC voltage is distributed across the groundwall insulation and the tube to copper insulation. Part of the applied voltage is coupled to the vent tubes **30** through the distributed capacitance C3. The vent-tube **30**-to-copper-strand insulation is then subject to the high voltage stress level which if high enough can lead to insulation failure. Insulation failure due to overvoltage can result in copper-to-vent-tube shorting. Once two or more shorts occur, excessive current can flow in the vent tubes **30**. Excessive current in the vent tubes **30** can cause the vent tubes **30** to melt and reduce the cooling effectiveness. Complete coil failure can then follow due to overheating of the coil **30**. To minimize the possibility of a copper-to-tube short, it is advantageous to reduce the potential difference between the cooling tubes **30** and copper strands **22**.

An equivalent circuit of the cross-section of an inner cooled coil is shown in FIG 8. With an AC voltage applied to the coil **30** between the copper strands **22** and the ground electrode, a portion of the AC voltage is coupled through the capacitance (C2) that exists between the top and bottom cooling tubes and the copper coil. This coupled voltage results in a large potential difference between the cooling tubes and the coil copper. The voltage drop across a capacitance (C1) is the voltage stress between the tube and copper strands

(across the insulation). The magnitude of the voltage (VD2), depends on the relative values of the distributed capacitance (C1 and C2). The magnitude of potential (VC2) is equal to V1(SC2/(XC2+XC3)). The magnitude of the potential (VC2) can reach several hundred volts with coil rated voltage of V1. The insulation between the copper and vent tubes will fail if VC2 exceeds the dielectric strength of the insulation. Once voltage breakdown occurs, then it is possible to have the copper short to the vent tube.

Reducing the coupled value of V2 can be obtained by reducing the value of the impedance associated with XC2 and this impedance can be reduced by placing a low impedance (resistance) across the C2 coupling capacitor. A low impedance connected from the coil copper to each vent tube will reduce the magnitude of the voltage (VC2) distributed between the vent tubes and copper.

FIG. 1 illustrates stator coils **20** of a power generation system **10** which has a rotor **12** and a stator **15** positioned adjacent, e.g., surrounding, the rotor **12** as understood by those skilled in the art. The stator **15** preferably includes a plurality of high voltage stator coils **20** as illustrated. Each of the plurality of stator coils **20** includes a plurality of metal coil strands **22** preferably formed of copper or a copper alloy, a plurality of vent members **30**, e.g., preferably provided by vent or cooling members having a tubular shape, positioned adjacent the plurality of coil strands **22**, and compact voltage grading means **40** compactly contacting each of the plurality of vent members **30** for grading voltage between the plurality of metal vent members **30** and the plurality of metal strands **22** to thereby prevent an overvoltage condition.

As perhaps best shown in FIGS. 2-4, the compact voltage grading means **40** is preferably provided by a

compact overvoltage protector which preferably includes at least a first conductive strip member **42** contacting a conductive portion of each of the plurality of vent tubes **30**, a voltage grading layer **44** of material positioned to contact the first conductive strip member **42**, and at least a second conductive strip member **48** positioned to contact the plurality of metal strands **22** and the voltage grading layer **44** to thereby provide an electrical flow path between the vent tubes **30** and the metal strands **22**. For compactness and access to the inner vent tubes **30**, the voltage grading layer **44** preferably includes a plurality of layers **45** of conductive tape. As perhaps best illustrated in FIGS. 3-4, the plurality of layers of tape include a first layer **46** of conductive tape positioned to adhere to each of the plurality of vent tubes **30** and the first conductive strip member **42**, and a second layer **47** of conductive tape positioned to adhere to the plurality of vent tubes **30** and the second conductive strip member **48**. The compact voltage grading means **40** can further include conductive filler material **25**, e.g., conductive Roebel filler such as a resin-rich fleece material, positioned to contact surfaces of the plurality of coil strands **22**, the first and second strip members **42, 48** and the voltage grading layer **44** to enhance decreasing of a voltage potential between the plurality of metal strands **22** and the plurality of vent tubes **30**.

The stator coils **20** also preferably include bonding filler material positioned to contact the conductive filler material of the compact voltage grading means **40** to bond the compact voltage grading means **40** to the plurality of stator coils **20**. Each of the plurality of vent members **30** preferably has tubular shape and is

positioned in a stacked relationship as illustrated in FIGS. 2 and 5-6. The plurality of metal strands **22** are positioned on each side of the stack of tubular-shaped vent members **30**.

FIGS. 5-6 illustrate a stator coil according to the present invention which is compact and effective for solving the overvoltage problems. A slit is made in the vent tube insulation and a thin length of copper foil is slid under the vent tube insulation. The dimensions of the copper foil piece, for example, can be about 0.003 inches thick, about .250 inches wide, and about 1.5 inches long. The copper foil is very flexible. All vent tubes **30** have the tube insulation slit on the sides of the vent tubes **30** as shown in FIG. 5. After placement of the copper foil under the vent tube insulation, to make good electrical contact with the metal tube, a layer of conductive tape, with about 1000 ohms/square resistance is wrapped around the vent tube stack making certain the conductive tape is in good electrical contact with the copper foil strips. The copper foil strips are laid over the outer surface of the first layer **46** of conductive tape. A second layer **47** of conductive tape is wrapped around the vent tube stack and covers all the exposed copper foils on the vent tube sides. A thin copper strip of dimensions of about 0.003 inches thick, about 0.250 inches wide, and about equal to the length of the coil, is soldered to a copper strand at one end and extended substantially the entire length of the stator coil **20** on both the coil top and bottom. The copper foil strip lays against the top surface of the insulated top and bottom vent tube and is insulated from both the copper strands **22** and the vent tubes **30**. To prevent coil current from flowing in the copper strip, it is connected to the copper strands **22** only at one end of the coil. A conductive Roebel filler

material is then applied to both the top and bottom surface of the coil. The conductive Roebel filler makes good electrical contact with the copper strip and forces the potential to be the same magnitude along the coil length. The conductive tape wrapped around the vent tube stack also makes electrical contact with the top and bottom Roebel filler and makes the high resistance connection between coil copper and vent tubes. This resistance forces the voltage between the vent tubes **30** and copper strands **22** to be of a low, safe value to protect the vent-tube-to-copper insulation from an overvoltage condition. The resin rich side filler material that is used for coil consolidation along with the resin rich top and bottom Roebel filler bonds the complete grading system together during coil processing.

As illustrated in FIG. 9, a vent tube voltage distribution test was conducted on an inner cooled stator coil **20** according to the present invention. The purpose of the test was to obtain a measure of the voltage level coupled to the vent tubes **30** during normal coil operation. Results indicate that with a stator coil **20** operating at about 8kVrms, about 504 volts rms will be dropped between the vent tubes **30** and copper strands **22**. The failure voltage for the vent-tube-to-copper-strand insulation is on the order of about 700 to 1000 volts rms. Therefore vent tube voltage grading can advantageously be used on this coil design. With the invention applied to the vent tubes **30**, the voltage measured between vent tubes **30** and copper strands **22** was on the order of about 5 volts rms with about 8 kVrms on the coil. The plot of the voltage between vent tubes **30** and copper strands **22** is shown in FIG. 9.

As shown in FIGS. 1-9, the present invention also includes a method of grading voltage between internal or inner positioned vent members **30** and conductive strands

22 of a high voltage coil **20** of a power generation system **10**. A method preferably includes connecting conductive portions of each of a plurality of internal or inner vent members **30** to a plurality of conductive strands **22** of a high voltage coil **10**. The connecting step for each vent member **30** preferably includes forming an opening in insulation **24**, e.g., tube to strand insulation, surrounding the vent members **30**, positioning a first conductive strip member **42** to contact conductive portions of the vent member **30**, positioning a voltage grading layer **44** of material to contact and overlie the first conductive strip member **42**, and positioning a second conductive strip member **48** to contact the voltage grading layer **44** and at least one of the plurality of conductive strands **22**.

Also, the voltage grading layer **44** preferably includes a plurality of layers **45** of conductive tape, and the step of positioning the voltage grading layer **42** preferably includes adhering a first layer **46** of conductive tape to the first metal strip member **42** and the insulation **24** surrounding the vent member **30** and adhering a second layer **47** of conductive tape to the insulation **24** and the second conductive strip member **48**. The method can also include positioning conductive filler material **25** to contact the plurality of conductive strands **22**, the first and second conductive strip members **42, 48**, and the first and second layers **46, 47** of voltage grading layer **45**.

Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings.

Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed, and that modifications and embodiments are intended to be included within the scope of the appended claims.

THAT CLAIMED IS:

1. A power generation system comprising:

a rotor; and

a stator positioned adjacent the rotor, the stator including a plurality of high voltage stator coils, each of the plurality of stator coils including a plurality of metal coil strands, a plurality of metal vent members positioned adjacent to the plurality of coil strands, and compact voltage grading means contacting each of the plurality of vent members for grading voltage between the plurality of vent members and the plurality of metal coil strands to thereby prevent an overvoltage condition.

2. A system as defined in Claim 1, wherein the compact voltage grading means includes at least a first conductive strip member contacting a conductive portion of each of the plurality of vent members, a voltage grading layer of material positioned to contact the first conductive strip member, and at least a second conductive strip member positioned to contact the plurality of metal coil strands and the voltage grading layer to thereby provide an electrical flow path between the metal vent members and the metal coil strands.

3. A system as defined in Claim 2, wherein the voltage grading layer includes a plurality of layers of conductive tape, the plurality of layers including a first layer of conductive tape positioned to adhere to each of the plurality of vent members and the first conductive strip member, and a second layer of conductive tape positioned to adhere to the plurality of vent members and the second conductive strip member.

4. A system as defined in Claim 2, wherein the compact voltage grading means further includes conductive filler material positioned to contact

surfaces of the plurality of coil strands, the first and second strip members, and the voltage grading layer to enhance decreasing of a voltage potential between the plurality of metal strands and the plurality of metal vent members.

5. A system as defined in Claim 4, wherein each of the stator coils further includes bonding filler material positioned to contact the conductive filler material of the compact voltage grading means to bond the compact voltage grading means to the plurality of stator coils.

6. A system as defined in Claim 5, wherein each of the plurality of vent members has tubular shape and are positioned in a stacked relationship, and wherein the plurality of metal coil strands are positioned on each side of the stack of tubular-shaped metal vent members.

7. A high voltage stator coil for a stator of a power generation system, the stator comprising:

a plurality of metal strands;

a plurality of vent members positioned adjacent the plurality of metal strands; and

compact voltage grading means contacting each of the plurality of vent members and the plurality of metal strands for grading voltage between the vent members and the metal strands to thereby prevent an overvoltage condition.

8. A stator coil as defined in Claim 7, wherein the compact voltage grading means includes at least a first conductive strip member contacting a conductive portion of each of the plurality of vent members, a voltage grading layer of material positioned to contact the first conductive strip member, and at least a second conductive strip member positioned to contact the

plurality of metal strands and the voltage grading layer to thereby provide an electrical flow path between the vent members and the metal strands.

9. A stator coil as defined in Claim 8, wherein the voltage grading layer includes a plurality of layers of conductive tape, the plurality of layers including a first layer of conductive tape positioned to adhere to each of the plurality of vent members and the first conductive strip member, and a second layer of conductive tape positioned to adhere to the plurality of vent members and the second conductive strip member.

10. A stator coil as defined in Claim 9, wherein the compact voltage grading means further includes conductive filler material positioned to contact surfaces of the plurality of coil strands, the first and second strip members, and the voltage grading layer to enhance decreasing of a voltage potential between the plurality of metal strands and the plurality of vent members.

11. A stator coil as defined in Claim 10, further comprising bonding filler material positioned to contact the conductive filler material of the compact voltage grading means to bond the compact voltage grading means.

12. A stator coil as defined in Claim 11, wherein each of the plurality of vent members has tubular shape and is positioned in a stacked relationship, and wherein the plurality of metal strands are positioned on each side of the stack of tubular-shaped vent members.

13. An overvoltage protector for a power generation system, the protector comprising:

at least a first conductive strip member positioned to contact one of a plurality of vent members;

a voltage grading layer of material positioned to contact the first conductive strip member; and

at least a second conductive strip member positioned to contact the voltage grading layer and at least one of a plurality of conductive coil strands forming a portion of a high voltage coil.

14. A protector as defined in Claim 13, wherein the voltage grading layer includes a plurality of layers of conductive tape, the plurality of layers including a first layer of conductive tape positioned to adhere to each of the plurality of vent members and the first conductive strip member, and a second layer of conductive tape positioned to adhere to the plurality of vent members and the second conductive strip member.

15. A protector as defined in Claim 14, further comprising a conductive filler material positioned to contact surfaces of the plurality of coil strands, the first and second strip members, and the voltage grading layer to enhance decreasing of a voltage potential between the plurality of metal strands and the plurality of vent members.

16. A method of grading voltage between internal vent members and conductive strands of a high voltage coil of a power generation system, the method comprising:

connecting conductive portions of each of a plurality of internal vent members to a plurality of conductive strands of a high voltage coil.

17. A method as defined in Claim 16, wherein the connecting step for each vent member includes:

forming an opening in insulation surrounding the vent members;

positioning a first conductive strip member to contact conductive portions of the vent member;

positioning a voltage grading layer of material to contact and overlie the first conductive strip member; and

positioning a second conductive strip member to contact the voltage grading layer and at least one of the plurality of conductive strands.

18. A method as defined in Claim 17, wherein the voltage grading layer includes a plurality of layers of conductive tape, and wherein the step of positioning the voltage grading layer includes adhering a first layer of conductive tape to the first metal strip member and the insulation surrounding the vent member and adhering a second layer of conductive tape to the insulation and the second conductive strip member.

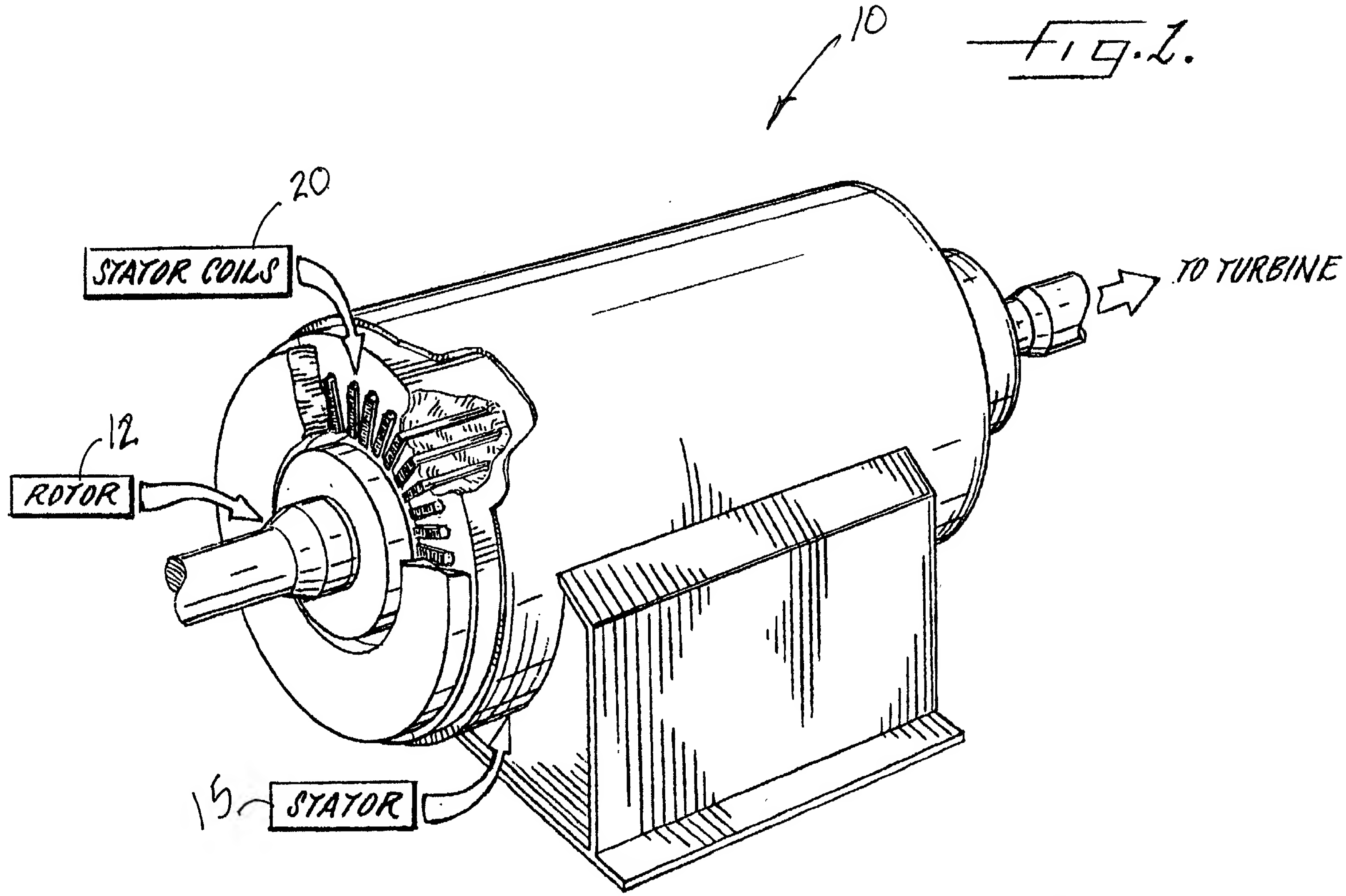
19. A method as defined in Claim 18, further comprising the step of positioning conductive filler material to contact the plurality of conductive strands, the first and second conductive strip members, and the first and second layers of voltage grading layer.

POWER SYSTEM HAVING STATOR COILS FOR GRADING VOLTAGE BETWEEN INNER VENT TUBES AND COIL STRANDS AND ASSOCIATED METHODS

Abstract Of The Disclosure

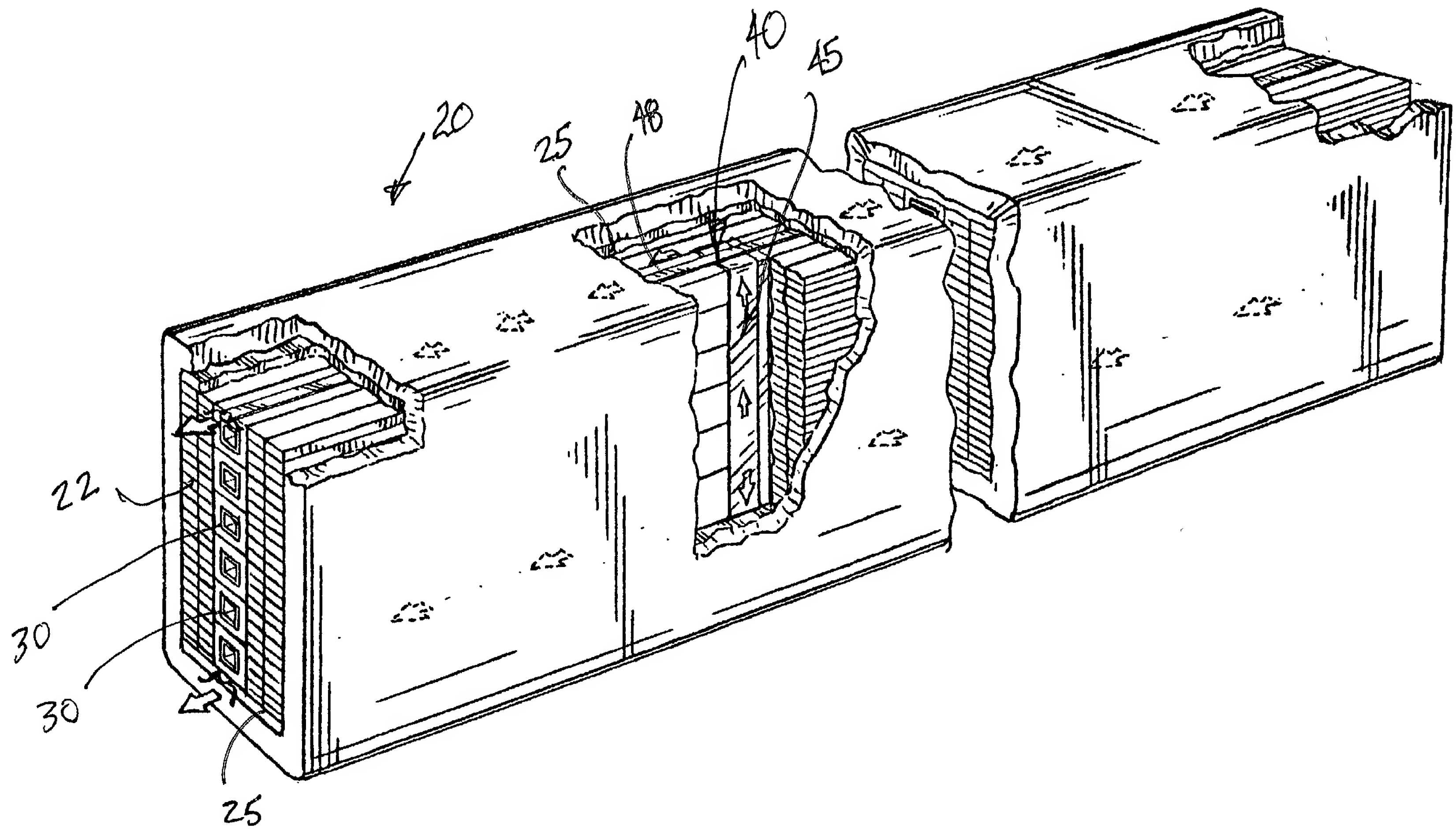
A stator for a power generation system and associated methods are provided. The stator preferably includes a plurality of high voltage stator coils. Each of the plurality of high voltage stator coils preferably includes a plurality of metal strands, a plurality of vent members positioned adjacent the plurality of metal strands, and compact voltage grading means contacting each of the plurality of vent members and the plurality of metal strands for grading voltage between the vent members and the metal strands to thereby prevent an overvoltage condition. The present invention also provides a method of grading voltage between internal vent members and conductive strands of a high voltage coil of a power generation system. The method preferably includes connecting conductive portions of each of a plurality of internal vent members to a plurality of conductive strands of a high voltage coil.

Fig. 1.



POWER GENERATOR

Fig. 2.



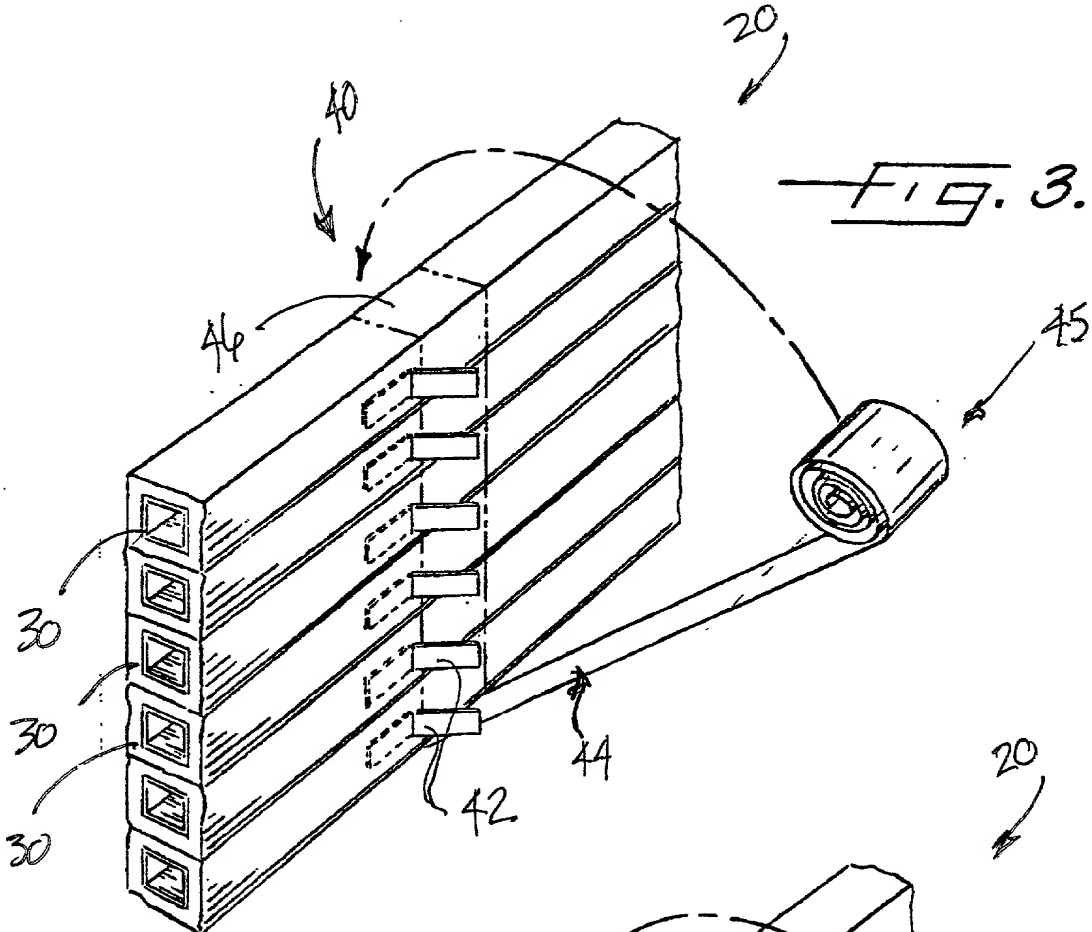


Fig. 3.

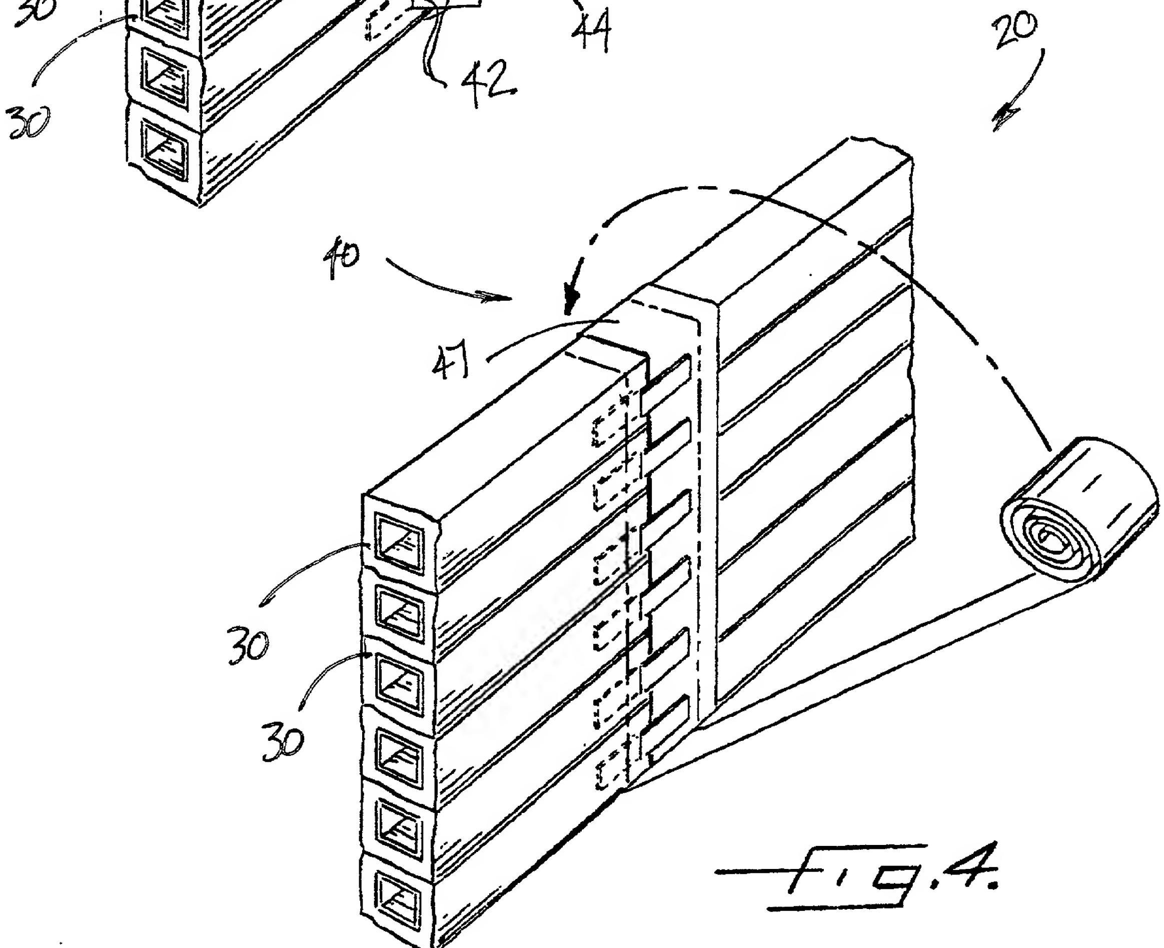
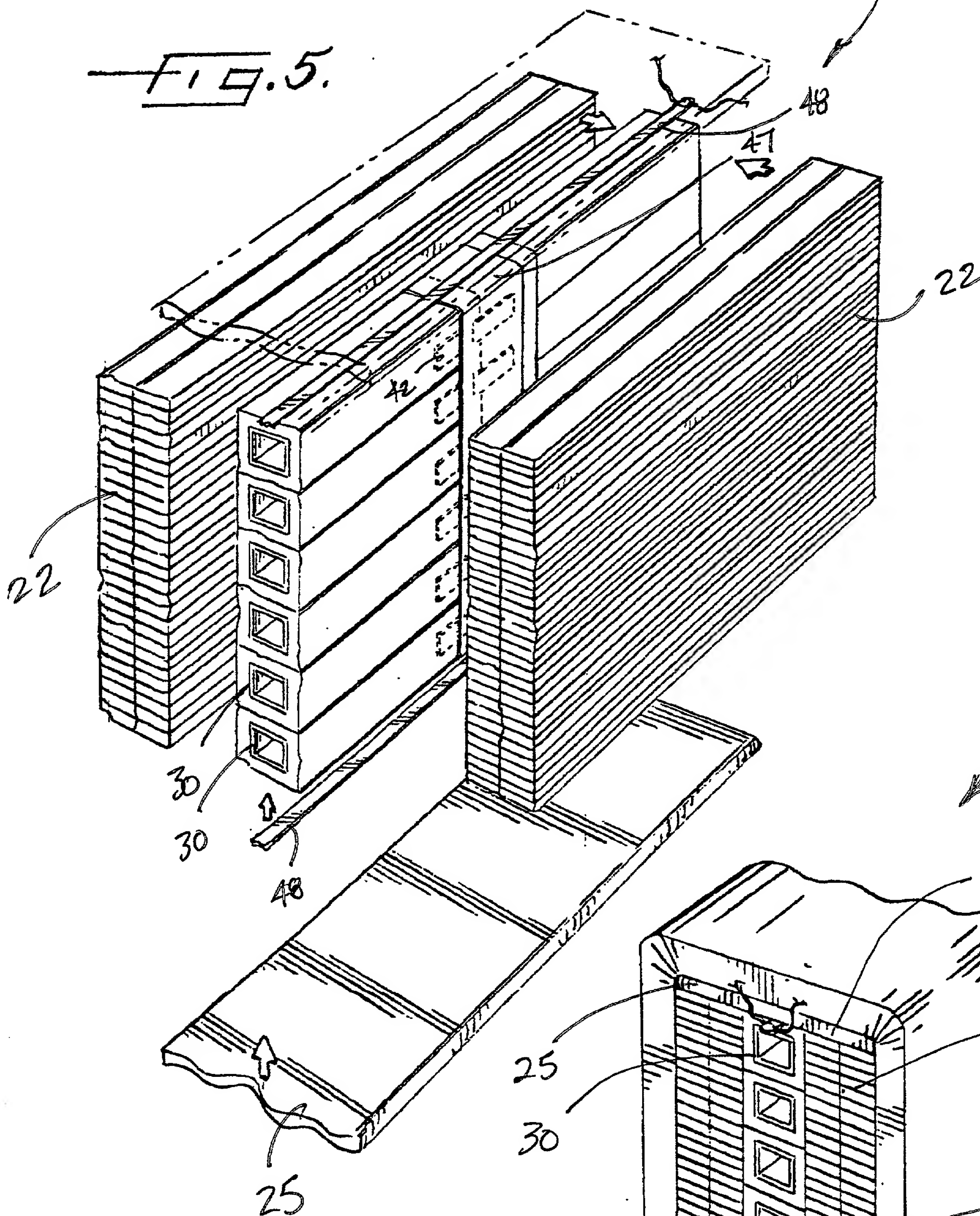


Fig. 4.

Fig. 5.



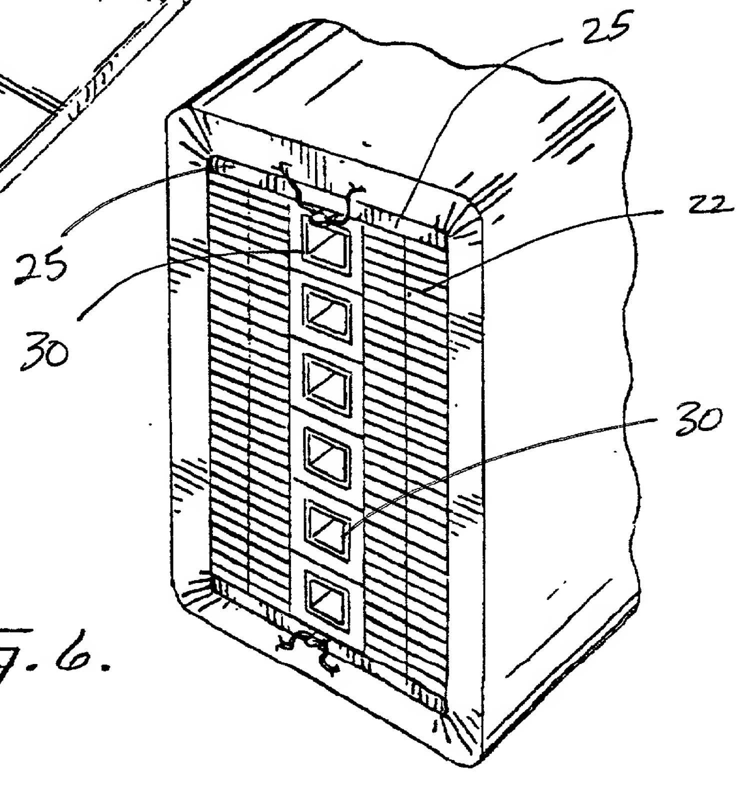
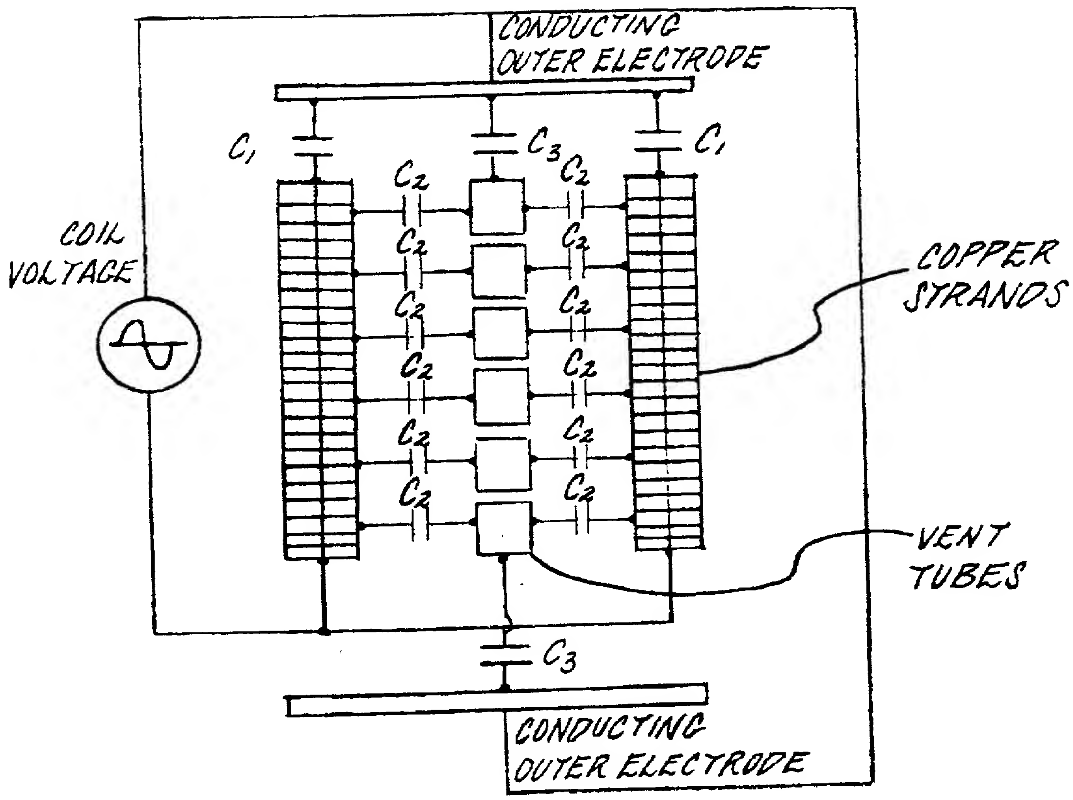


Fig. 6.

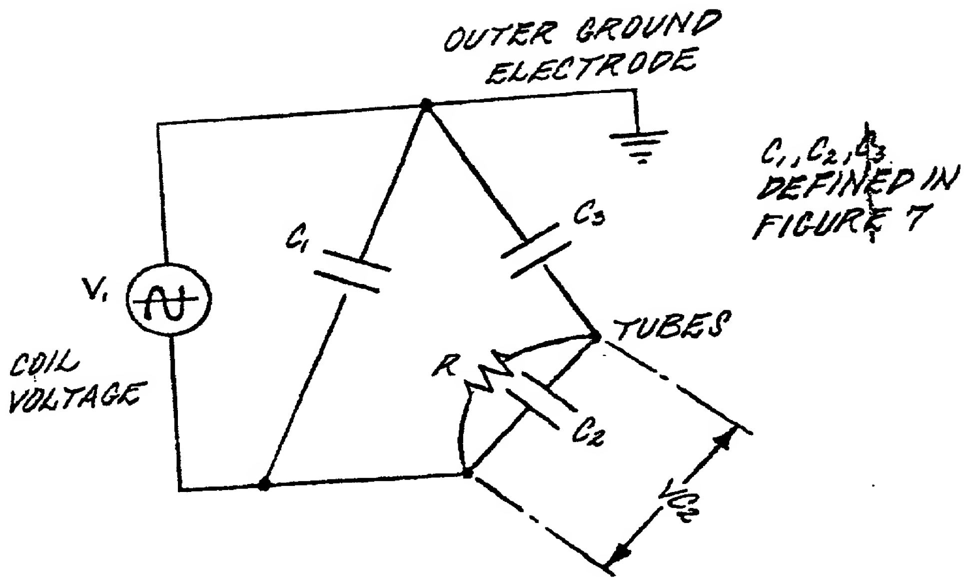


C_1 - CAPACITVE COUPLING BETWEEN OUTER ELECTRODE TO COPPER STRANDS

C_2 - CAPACITIVE COUPLING BETWEEN COPPER STRANDS AND ALL COOLING TUBES

C_3 - CAPACITIVE COUPLING BETWEEN OUTER ELECTRODE AND TOP AND BOTTOM TUBES (TOP SURFACE OF TUBES ONLY)

FIG. 7.



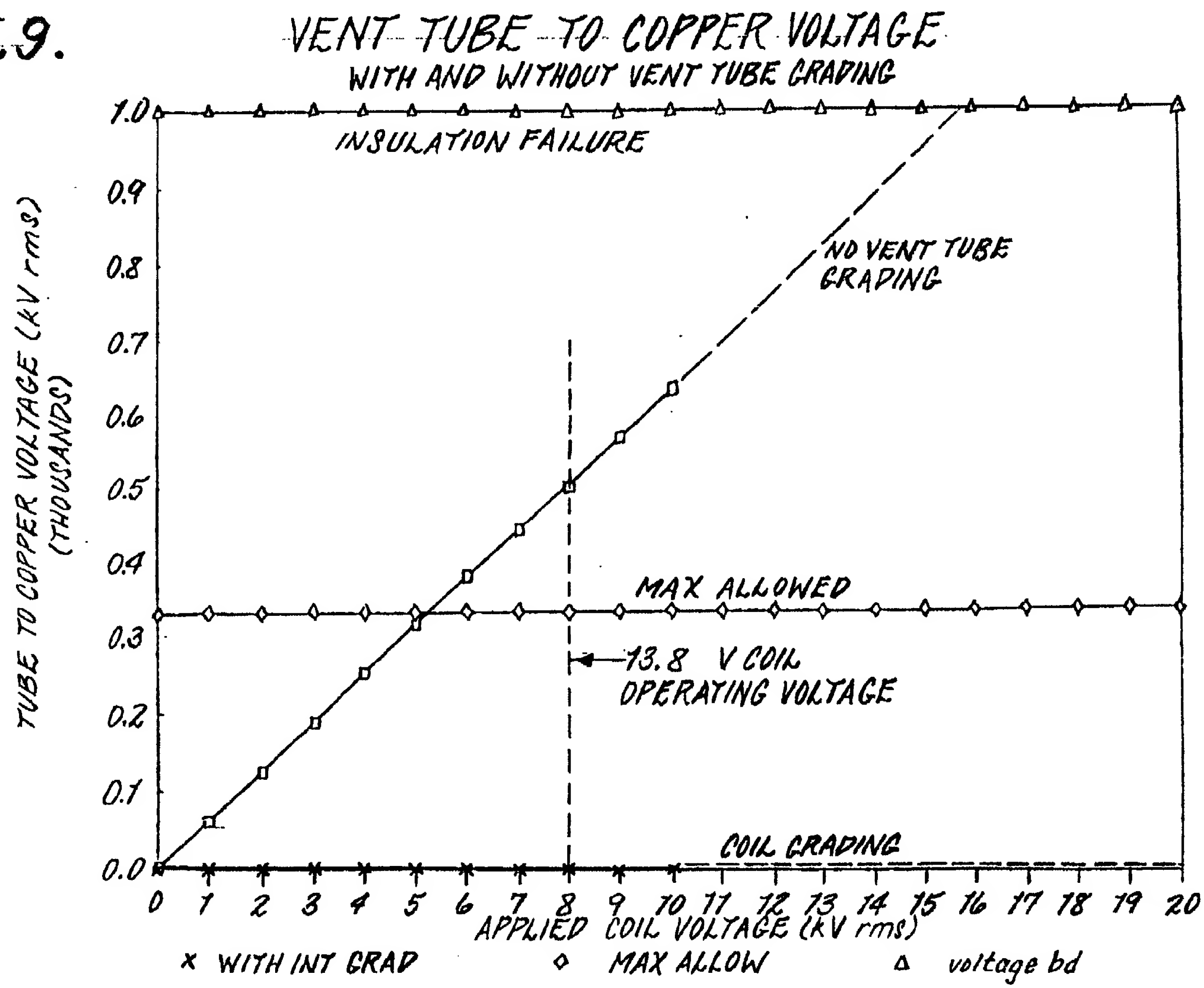
VOLTAGE BETWEEN TUBES AND COPPER = VC_2

$$VC_2 = \frac{XC_2}{XC_3 + XC_2} \cdot V_1 \qquad X = \text{CAPACITOR REACTANCE}$$

$R \equiv$ VOLTAGE GRADING RESISTOR

Fig. 8.

Fig. 9.



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Attorney Docket No.: 00P7928US

DECLARATION FOR PATENT APPLICATION & POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

POWER SYSTEM HAVING STATOR COILS FOR GRADING VOLTAGE BETWEEN INNER VENT TUBES AND COIL STRANDS AND ASSOCIATED METHODS

the specification of which
_X_ is attached hereto, and
__ was filed on ________ as Application Serial No. _______
and was amended on __________ (if applicable)

Listing of named inventor(s): **FRANKLIN T. EMERY**

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Codes, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S) Priority claimed

(Number)	(Country)	(Day/month/year filed)	Yes	No
(Number)	(Country)	(Day/month/year filed)	Yes	No

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER FILING DATE

I hereby claim the benefits under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, we acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.) (Filing date) (Status)
(patented, pending, abandoned)

Attorney Docket No.: 00P7928US

Power of Attorney: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

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All powers of attorney previously granted in this matter are hereby revoked.

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I hereby declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Full name of sole or first inventor: FRANKLIN T. EMERY

Franklin T. Emery Date: 9/25/00
Inventor's Signature

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